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ABSTRACT

Computerized adaptive tests (CATs) make it possible to estimate the ability of each student during the testing process. The computer presents items to students at the appropriate level, and students take different versions of the same test. Computerized testing increases the flexibility of test management in that: (1) tests are given on demand and scores are immediately available; (2) differences among administrators cannot affect scores and trained administrators are not needed; (3) tests can be individually paced; and (4) test security is increased. Computerized testing also offers options for timing and formatting, increases efficiency, and can provide accurate scores over a wide range of abilities. Some limitations to CATs are considered. CATs are not appropriate for some subjects and skills. Hardware limitations restrict the types of items that can be administered by computer, and many schools simply do not have the resources to administer CATs. A relatively large sample is needed to norm test items; comparable scores depend heavily on the quality of the estimates of item characteristics because each student answers a different set of items. The military has been among the pioneers in using CATs and at least two public school systems have begun to use them. A list of six organizations involved in computerized adaptive testing is included. (SLD)

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Computerized Adaptive Tests

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Paper-and-pencil tests are "fixed-item" tests in which all students answer the same questions. Fixed-item tests may waste students' time because they may give students a large number of items that are either too easy or too difficult. As a result, the tests often give little information about the particular level of ability of each student. With recent advancements in measurement theory and the increased availability of microcomputers in schools, the practice of using these tests may change.

With computerized tests, each student's ability level is estimated **during** the testing process. The computer gives items to the student that are at an appropriate level. Students take different versions of the same test. These tests are called *computerized adaptive tests* or *CATs*. This digest offers some insights into the advantages and disadvantages of CATs.

What Are the Advantages of CATs?

In general, computerized testing greatly increases the flexibility of test management.

- Tests are given "on demand" and scores are available immediately.
- Neither answer sheets nor trained test administrators are needed. Because administration is always the same, differences among test administrators cannot affect the scores.
- Tests can be individually paced so that a student does not have to wait for others to finish before going on to the next section. Self-paced administration also offers extra time for students who need it, potentially reducing one source of test anxiety.
- Test security is increased because there are no hardcopy test booklets.

Computerized testing also offers a number of options for timing and formatting. Timing options range from self-paced administration to item-by-item timing. Also, different formats can be developed to take advantage of graphics and timing capabilities. For example, perceptual and psychomotor skills that are nearly impossible to assess with a paper-and-pencil test can be readily tested on a computer.

In addition to having the advantages of computerized testing, CATs increase efficiency. Significantly less time is needed to administer CATs than a fixed-item test since fewer items are needed to achieve acceptable accuracy. CATs can reduce testing time by more than 50% while maintaining the same level of reliability. Shorter testing times also reduce fatigue, which can be a significant factor in students' test results.

CATs can also provide accurate scores over a wide range of abilities. While traditional tests are usually most accurate for average students, CATs can maintain a high level of accuracy for all students. By including more relatively easy and more relatively difficult items in the item pool, CATs can accommodate the abilities of both slow and bright students.

What Are the Limitations of CATs?

CATs should not be used for some subjects and skills. Most CATs are based on an item-response theory model, which assumes that all the information needed in selecting items can be summarized in one to three parameters that describe the item's difficulty for students who have different abilities. Many tests cover a number of different skills or topics, however. Specifications for traditional tests seek to ensure an even range across skills or topics. Most common CAT strategies do not accommodate such additional considerations.

Hardware limitations further restrict the types of items that can be administered by computer. Items involving detailed art work and graphs or extensive reading passages, for example, are hard to present using the types of computers found in most schools.

Another limitation of CATs stems from the need for careful item calibration. Because each student answers only a different set of items, comparable scores depend heavily on the quality of the estimates of item characteristics. Therefore, relatively large samples of students must be used to norm the item. A minimal

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number in a sample is 1,000 students; 2,000 is more common. Such sample size requirements are prohibitive for most locally developed tests.

Finally, for CATs to be manageable, a facility must have enough computers for a large number of students and the students must be at least partially computer-literate. While the number of computers in schools continues to grow, many schools simply do not have the resources to use CATs as a standard practice.

Who Is Using CATs Now?

CATs are new and the number of companies and organizations using them is small. However, several prominent organizations are already using CATs.

For example, for the past decade, the U. S. military has pioneered basic and applied research in CATs. One step in this research program is the development of a computerized version of the Armed Services Vocational Aptitude Battery (ASVAB), headed by the Naval Personnel Research and Development Center in San Diego. Administered to roughly a half million applicants each year, the paper-and-pencil version of the ASVAB takes three hours to complete. The experimental CAT version takes about 90 minutes. With the computerized version, an examinee's qualifying scores can be immediately compared with requirements for all available positions.

Another test developed by military research laboratories -- the Computerized Adaptive Screening Test (CAST) -- was implemented in 1984. CAST was the first nationwide use of CAT. This 15-minute screening test gives prospects a quick but accurate estimate of their chances of passing the full ASVAB and of qualifying for enlistment bonuses.

At least two public school systems use CATs. In Portland (OR) Public Schools, CATs have been well received by examinees, test administrators, and test users. Montgomery County (MD) Public Schools has asked for approval from the State Board of Education to make its mathematics and reading CATs available to students as an alternative to the state-sponsored high school graduation examinations.

Which Businesses Are Involved in CATs?

The following six organizations are now involved in computerized adaptive testing:

- **Assessment Systems Corporation** markets the MicroCAT system, which runs on IBM-PCs and compatibles. MicroCAT is a complete authoring and administration system and includes routines for item analysis and item-pool development.
- **Wicat** markets software to support CAT developers, a battery of 45 tests, and custom CAT computer systems. Schools use Wicat's battery of CATs to screen and identify gifted and talented students.
- **The Psychological Corporation** markets a CAT version of the popular Differential Aptitude Test (DAT) to junior and senior high schools. It has versions for the IBM-PC and Apple II computers.
- **American College Testing Program** (ACT) is working on several computerized adaptive tests. ACT is developing training CATs for the Marine Corps and for college placement mathematics. It is also researching the development of a multidimensional CAT.
- **The Educational Testing Service** is working with the College Entrance Examination Board to develop and refine a CAT to aid in college placement. An initial version of the system is being used by about 20 colleges across the country.
- **The American Institutes for Research** recently completed a major revision of the Army's Computerized Applicant Screening Test (CAST). In revising CAST, AIR expanded the item pool, analyzed the tests for fairness to women and minorities, and modified procedures for selecting items so that the revised test is more accurate. AIR researchers also significantly improved the reports that the examinees and the Army recruiters set from the test.

Additional Reading

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